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# *Aegle marmelos*- Effect of Seed size and pre-sowing treatment on seed germination

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ABSTRACT

*Aegle marmelos* (L) corr. is a medicinal tree, mentioned in Charka Samhita and mentioned as necessary item in Ayurvedic medicine. Its fruits and leaves are used to treat dysentery, dyspepsia, neurological disease, edema, vomiting, and rheumatism. Seeds of Bael were collected from three locations in Rajasthan. These seeds were after proper cleaning and storage was tested for germination vigour and other parameters using different treatments and growth regulators in different concentrations. It was found that about 50 percent of germination occurs in freshly harvested seeds without any growth regulators and with $GA_3$ it increases to 75 percent. Various other parameters viz. mean germination time and average germination percentage etc of all three seedlots were tested and presented in this paper.

**Keywords:** Medicinal tree; Ayurvedic medicine; Seed germination; Storage conditions; Hydro priming; Seedling vigor; Nursery techniques.

## 1. Introduction

*Aegle marmelos* (L) corr. is a medicinal tree that belongs to rutaceae family and its various parts are used in Ayurvedic and Siddha medicines to treat a variety of ailments. This plant is one of the medicinally treasured tree species (Chanda, 2008) out of the 250,000 living terrestrial plant species on Earth. Bael is also known as begal-quince, golden apple and stone apples in India (Kintzios, 2006) and is a sacred tree in the place where Hindu lives. Bael trees are usually planted near temples dedicated to Lord Shiva and worshiped by the devotes (Singhal *et al.*, 2001). Bael is highly habituated to the tropical and sub-tropical climates of India, Burma, Pakistan, Bangladesh, Sri Lanka, Northern Malaya, Java, and the Philippines (Islam *et al.*, 1995).

*Aegle marmelos* is a medium-sized tree, dimorphic branches, alternate, trifoliate and deep green leaves large sweet-scented, greenish-white flowers, large and globose fruits (Purohir & Vyas, 2005). According to one study approximately 200 to 250 kg of fruits could be obtained per tree (Mazumdar *et al.*, 2006). It is a moderate tree 6-7.5 m in height and 90-120 cm in girth. In fruit pulps, there are 10-15 seeds.

Almost all parts of the tree are used in preparing herbal medicine (Kala, 2006). The roots are useful for treating diarrhea, dysentery and dyspepsia.

Bael is mentioned in Charka Samhita and mentioned as necessary item in Ayurvedic medicine (Roy and Singh, 1979). Herbal medicines are heavily used and immensely popular in developing countries (WHO, 2015). Bael fruits and leaves are used to treat dysentery, dyspepsia, neurological disease, edema, vomiting, and rheumatism (Chanda, 2008). It is also reported as industrial food processing items and also an excellent source of commercially important herbal compounds.

Bael has occurred in India since 800 B.C. as a crop according to historical reports (Nagar *et. al.*, 2017). Bael is a subtropical species although it can grow well in tropical environments. It can thrive well in high altitude as high as 1200 meters and withstand without any significant growth retardation at 50 $^0$C and -7 $^0$C. In prolonged droughts,

fruiting may cease but the plant can survive with shallow soil moisture. Bael trees generally require well-drained soil.

## 2. Review of Literature

The dried seeds of *Aegle marmelos* (1200 Number) with weighed 89.6 gm were selected for the study. They were divided randomly into 6 groups each contending 50 seeds for study at different moisture content level i.e. 18.9, 13.8, 6.3 and 4.47 percent. Each groups and effect of temperature on germinator was recorded at different temperature viz 30°, 20°, 10°, 0°- 20° and -196° C. Seeds were moist with distilled water and moisture content was calculated after seeds were dried in dedicator by using $CaCl_2$ for 4 hours.

Results shows at 30 °C storage condition *Aegle marmolos* seeds showed 97, 92, 74 and 42 percent germination at moisture level of 18.9, 13.8,6.3 and 4.47 percent respectively. Simulate at the same variations in moisture level i.e. (18.9, 13.6, 6.3, and 4.47 percent) at 20 °C , 92,89,67 and 0 percent germination was observed.

At 10 °C and with same moisture levels (maintained in other temperature conditions) was 85, 76,61 and 0 percent while at temperature 0 °C only 18.9 and 13.8 percent moisture level was after to germination the seeds of same quality as was germination up to 97±4.06 percent under 30 °C and 18.9 percent relative humidity.

It was also observed that below freezing point viz -20 °C and -196 °C more of the provided and maintained moisture was found capable to germinator using of the single seed.

It was also observed that high moisture and more temperature i.e. 18.9 percent and 30 °C quickly initiate germination at about 9.76 days and decline is germination period was observed which reduced temperature was applied at same moisture level also.

More demand for days was observed when moisture level becomes 6.3 percent and took almost 60 percent more time. It is concluded that 0 °C, -20 °C and -196 °C with only of the applied moisture level close not produce any favorable results. At temperature about 0 °C pervades germination but percentage germination positively depends on difference in humidity. Therefore it is strongly recommended to store the fresh and untreated seeds of *Aegle marmelos* at 30 °C with 18.9 percent relative humidity to make more viable (Sharma *et. al.*, 2011).

Bael has numerous food pharmacological and other values. It could be considered as promising forest tree species in large-scale agriculture.

Different bael selections under the rain fed tropical Semi-arid western India Environment was characterized (Singh *et. al.*, 2014) bael genotypes were characterized in Bangladesh and 4 varieties were identified as superior genotypes (Uddin *et al.*, 2006).

A study was conducted for the selection of media for germination standardization of media and methodologies for germination test at room temperature in live with ISTA rules, seeds were sown in different media as river sand, quartz sand, vermiculite and germination pepper. Experiment was conducted at 35 °C and 95±2 percent relative humidity germination data recorded upto 23 days & shoot root length was recorded. Seedling were dived for 48 hours in an over maintained at 85 °C. Vigour index was recorded using formula V.I. = Germination percentage X Total Seedling length cm (Panse & Sukhathme 1995). The result revealed that either river sand or paper media

could be used for tainting reproducible and completed expression of germination of seeds. In river sand, in sand method (Seeds are to be sown at depth of 2cm) and in paper between paper (Roll towed) method had batter expressions for germination (83 and 78 percent) respectively and is recommended as best model (Venudevon *et. al.*, 2013)

To study effect of hydro priming (24 and 48 hours hydro priming) treatment along with control (without any treatment) on seed germination and seedling quality character of Bael (*Aegle Marmolos*). Results showed that the effect of Hydro priming was significant on seed germination percentage, seedling length, seeding vigour and dry production than control. It was concluded that water soaking treatment for 48 hours and 24 hours was significantly increase the germination percentage seedling weight and vigour indexes than control in *Aegle marmelos* priming may be helpful in reducing the risk of poor stand establishment under nursery conditions priming improved seed performance might be attributable in part to the decreased tipid pre-oxidation and increased ant-oxidative utilities during seed inhibitions. Simile Results were reported improvement of germination percentage. Significant increase in germination by hydro-primed seeds (Venudevon *et. al.*, 2013).

The resultant effect of priming depends on the adopted method and duration of treatment method and duration of treatment. Hydro priming is Sample technique and does not require special technique. It is the cheapest priming method.

## 3. Material and Methods

Seeds of *Aegle marmelos* were collected and after proper cleaning and drying they were stored for further analysis. Seed length, width and thickness were recorded for 100 seeds of each seed lot. The seed germination tests were performed in seed germination Laboratory of Silviculture and Forest Management, ICFRE- Arid Forest Research Institute, Jodhpur. With the help of seed counter machine seeds per kilogram were calculated. Laboratory test on the germination response of seeds to pre-germination treatments of Hot water, $GA_3$ (500 and 1000 ppm) and IBA $GA_3$ (500 and 1000 ppm) compared to untreated seeds **(**control**)**.

Soaking Hundred seeds in hot water for 15 min. Twenty seeds were also soaked in $GA_3$ (500 and 1000 ppm) and IBA $GA_3$ (500 and 1000 ppm) for 6 hours. All the pre-treated and untreated seeds were rinsed thoroughly in distilled water and were placed in germination tray. The experiment was carried out at room temperature in the laboratory. Seeds were considered germinated upon plumule emergence. The number of seeds that germinated was recorded while the percentage seed germination was calculated. The following procedure was made for different parameter determinations-

### 3.1. Formulas for various calculations

(a) **GP (Germination percentage)** = (Total number of seeds germinated/total number of seeds tested) × 100

Final Germination Percentage (FGP %) = Final no. of seeds germinated in a seed lot × 100

The higher the FGP value, the greater the germination of a seed population (Scott *et al.*, 1984).

(b) **MGT (Mean germination time)** = total (daily germination) × 1 day/total seed sowing

Mean Germination Time (MGT day) $= \Sigma f \cdot x / \Sigma f$

f=Seeds germinated on day x

The lower the MGT, the faster a population of seeds has germinated (Orchard, 1977).

- First Day of Germination FDG day = Day on which the first germination event occurred

Lower FDG values indicate a faster initiation of germination (Kader, 1998).

- Last Day of Germination LDG day = Day on which the last germination event occurred Lower LDG values indicate a faster ending of germination (Kader, 1998).

- Germination Rate Index GRI (%/day) =G1/1 + G2/2 +· · ·+ Gx/x

G1=Germination percentage × 100 at the first day after sowing, G2=Germination percentage × 100 at the second day after sowing.

(c) **AVG MGT (Average Mean germination time)** = Total MGT/Total number of days.

(d) **GV (Germination Value)** = (Total MGT/total germination) × (GP%/10).

## 4. Result

Seed germination studies indicate that 3 sample collected from Rajasthan and Gujrat in 2023 shows various seed size & germination percentage mean length of seed was highest as 6.7 mm in Mehsana, Gujarat sample while it was 6.65 mm in Ranakpur, Rajasthan sample and lowest as 6.6 mm in Udaipurwati, Jhunjhunu seedlots. Mean seed width was highest as 4.80 mm in Udaipurwati Jhunjhunu seed lot it was 4.65 mm in Mehsana, Gujarat seed lot and lowest as 4.38 mm in Ranakpur, Rajasthan seedlots. Mean thickness of seed was highest as 2.27 mm in Udaipurwati, Jhunjhunu seedlots while it was 2.08 mm in Ranakpur seedlots and lowest as 1.85 mm in Mehsana, Gujarat seedlots.

Seeds were treated with hot water and $GA_3$ 500 & 1000 ppm concentration beside control under control germination percentage was 40 percent in Udaipurwati, Jhunjhunu, 50 percent in Mehsana Gujarat and highest as 65 percent in Ranakpur, Rajasthan seedlots.

## 5. Conclusion

Seeds collected from different sources have small differences in their seed size. However, with regard to germination percentage, it was found normally 40 to 50 percent which may be increased up to 75 percent in different treated seedlots. Various other parameters also show significant differences in their performance. However, there is a need to explore multiple seed sources performance based on different agro-climatic zones and also study on seed viability with different times periods is also need to be studied. *Aegle marmelos* is an important medicinal plant with cooling potential especially in hot areas.

## 6. Future Recommendations

A detailed study with reference to its reproductive biology needs to be studied to better understand the mechanism. To produce quality seedlings various parameters should be studied thoroughly. Similarly to increase germination and field performance various treatments and edaphic factors, microclimate also need attention.

**Declarations**

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**Competing Interests Statement**

The authors declare no competing financial, professional, or personal interests.

**Consent for publication**

The authors declare that they consented to the publication of this study.

**Authors' contributions**

All the authors took part in literature review, analysis, and manuscript writing equally.

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**Table 1.** Effect of seed Size on Germination in *Aegle marmelos*

| S.No. | Location | GPS | Date of Collection | Seed Analysis | | | Germination Percentage | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Mean Length (mm) | Mean Width (mm) | Mean Thickness (mm) | Control | Hot Water | $GA_3$ 500 PPM | $GA_3$ 1000 PPM |
| 1. | Near RFO Office, Mehsana Gujarat | N 23°58'6761' | 23-06-2023 | 6.7 | 4.65 | 1.85 | 50 | 65 | 70 | 70 |
| | | 72° E 36'9949' | | | | | | | | |
| 2. | Maga, Sayra, Ranakpur | N 25°06.827' | 24-03-2023 | 6.65 | 4.38 | 2.08 | 65 | 55 | 55 | 75 |
| | | E 73°44.403' | | | | | | | | |
| 3. | Inderpura, Udaipurwati, Jhunjhunu | N27°77'05.88" | 15-06-2023 | 6.6 | 4.8 | 2.27 | 40 | 65 | 65 | 70 |
| | | E75°47'32.53" | | | | | | | | |
| | Mean ± S.D. | | | 6.65± 0.05 | 4.61± 0.21 | 2.06 ± 0.21 | 51.66 ± 12.58 | 61.66 ± 5.77 | 63.33 ± 7.63 | 71.66 ± 2.88 |

**Table 2.** *Aegle marmelos* with Germination value and Mean Germination Time

| S.No. | Location | GPS | Date of Collection | Germination in Tray | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Treatments | GP% | Total MGT | Total GV | Average MGT | Average GV |
| 1. | Near RFO Office, Mehsana Gujarat | N23°58'6761' | 23-06-2023 | Control | 50 | 116.3 | 1405.29 | 7.75 | 93.69 |
| | | E72° 36'9949' | | Hot Water | 65 | 141.95 | 2218.56 | 9.46 | 147.9 |
| | | | | $GA_3$ 500 PPM | 60 | 138.8 | 1804.4 | 9.25 | 120.29 |
| | | | | $GA_3$1000PPM | 70 | 156.15 | 2297.14 | 10.41 | 153.14 |
| 2. | Maga, Sayra, Rankpur | N 25°06.827' | 24-03-2023 | Control | 65 | 104 | 989.3 | 4.7 | 45 |
| | | E 73°44.403' | | Hot Water | 55 | 107.2 | 1406.8 | 4.9 | 63.9 |
| | | | | $GA_3$ 500 PPM | 55 | 94.95 | 1456.2 | 4.3 | 66.2 |
| | | | | $GA_3$1000PPM | 75 | 128.2 | 3679 | 5.8 | 167.2 |
| 3. | Inderpura, Udaipurwati, Jhunjhunu | N27°77'05.88" | 15-06-2023 | Control | 40 | 73.95 | 471.17 | 4.93 | 31.41 |
| | | E75°47'32.53" | | Hot Water | 65 | 67.05 | 679.12 | 4.47 | 45.27 |
| | | | | $GA_3$ 500 PPM | 65 | 68.1 | 679.54 | 4.54 | 45.30 |
| | | | | $GA_3$1000PPM | 70 | 73.95 | 746.9 | 4.93 | 49.79 |
| | Mean ± S.D. | | | | 61.25± 9.79 | 105.88± 31.06 | 1486.11± 916.67 | 6.28 ± 2.26 | 85.75 ± 48.92 |

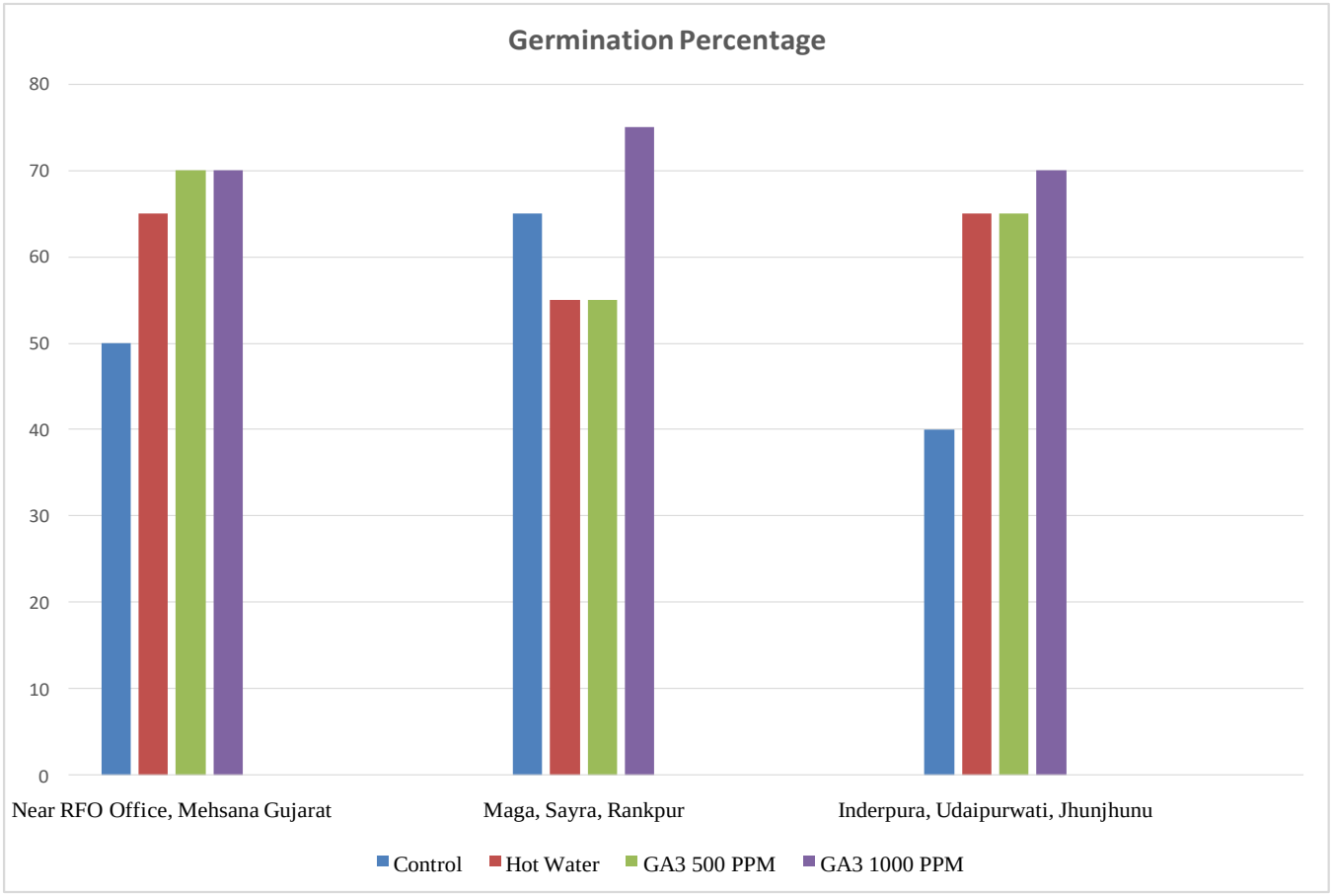


**Figure 1.** Seed collection of *Aegle marmelos*


**Figure 2.** Germination of *Aegle marmelos*